

Short Term Outcomes Of Pedicled Versus Skeletonized Internal Mammary Artery Grafts In Coronary Bypass Surgery

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Abstract

Background: The left internal mammary artery (IMA) is considered the cornerstone for grafting the left anterior descending (LAD) coronary artery with Pedicled and skeletonized techniques are the most commonly used harvesting techniques.

Objectives: The aim of this work is to study the short term clinical outcomes of both techniques.

Patients and methods: 100 patients requiring open heart surgery for isolated elective coronary artery bypass graft (CABG) were enrolled in this study. The patients were divided into two groups, 50 patients underwent pedicled left (IMA) harvesting and 50 patients underwent skeletonized left (IMA) harvesting, and all the patients had a 3-month follow-up.

Results: There was no significant difference in patients' demographic data between groups. The pedicled group was associated with an increased rate of post operative drainage (pedicled group versus skeletonized group) (486.0 ± 321.99 versus 338.0 ± 241.29) (P-value <0.001). There was no significant difference between both groups in regard to the duration of ventilation, intensive care unit stay, and arrhythmia. There was no significant difference between both groups in regard to sternal wound complications at three months follow up.

Conclusions: Pedicled left (IMA) and skeletonized left (IMA) short term outcomes are nearly equal except that the skeletonized technique is superior in regard to the amount of post operative drainage in comparison to the pedicled technique.

Keywords: Internal mammary artery; Pedicled; Skeletonized; CABG.

DOI: 10.21608/svuijm.2022.146247.1327

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Received: 21 June, 2022.

Revised: 27 June, 2022.

Accepted: 3 July, 2022.

Cite this article as: Eisa Abdellah Ahmed, Waheed Gamal Eldin Etman, Wael Mahmoud Hassanein, Bassem Adel Ramadan. (2022). Short Term Outcomes Of Pedicled Versus Skeletonized Internal Mammary Artery Grafts In Coronary Bypass Surgery. *SVU-International Journal of Medical Sciences*. Vol.5, Issue 2, pp: 336-347 .

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Introduction

Coronary artery bypass graft (CABG) surgery is considered the cornerstone for the management of multi-vessel severe coronary artery disease. Different grafts and conduits have been used and various studies have been done to improve surgical outcomes (Gaudino et al., 2015). The internal mammary artery (IMA) is considered the best choice conduit due to its association with significant improvement in both short and long-term results and better survival after performing (CABG) operation (Loop et al.,1986; Edwards et al.,1994;Cameron et al.,1996).

While the saphenous vein graft (SVG) is the most commonly used graft in CABG operations it has the risk of early atherosclerosis and obstruction. So the (IMA) conduit is considered superior to (SVG) in regard to the rates of long-term patency. About 90% of (IMA) grafts are still free of considerable stenosis after ten years (Berger et al., 2004).

Due to the long term survival benefits of the (IMA) and to obtain both short-term and long-term advantages, surgeons aim to harvest it in the best possible way. There are two techniques widely used for the harvesting of (IMA): as pedicled or as

skeletonized techniques. The pedicled method is conducted by dissecting the artery in association with its veins, fascia, adipose tissue, and lymphatics from the chest wall, while skeletonization is conducted by dissecting the (IMA) only without the surrounding structures (Saso et al., 2010).

The (IMA) graft impact in clinical application can vary, with different harvesting techniques that are used. Despite the popularity of the (IMA), however, it is still debated whether to use it as a pedicled graft or as a skeletonized graft as each technique has its own set of advantages and disadvantages (Mannacio et al.,2011; Hu et al.,2011).

The aim of this work is to study the short term clinical outcomes of skeletonized internal mammary artery harvesting versus pedicled internal mammary artery harvesting in coronary artery bypass surgery.

Patients and methods

An approval of the research was obtained from our institution Ethics Committee, and written informed consents were gained from all the patients enrolled in the study.

We conducted a prospective, observational study on 100 adult consecutive patients requiring open

heart surgery for an isolated elective coronary artery bypass graft (CABG). Patients required bilateral internal mammary artery harvesting, and those who were not compliant during the period of follow-up were excluded from the study.

Patients were divided according to the surgeons' preference into two equal groups. One group had pedicled internal mammary artery harvesting and the other group had skeletonized internal mammary artery harvesting.

Our study population was subjected to (CABG) surgery with the left internal mammary artery was anastomosed to the left anterior descending coronary (LAD) in all cases, saphenous vein grafts were used for the other anastomotic sites.

Pedicled technique

The left (IMA) was harvested by using electrocautery in association with its surrounding veins, muscle, and fascia, as a pedicled graft. The (IMA) was harvested starting from the upper border of the first rib to its bifurcation as the musculo-phrenic and superior epigastric arteries. All intercostal branches of the LIMA were clipped.

Skeletonized technique

The left (IMA) was dissected away from its associated venous drainage; muscle, fascia, innervations, and

lymphatics starting from the upper border of the first rib to its bifurcation and the branches of the (IMA) were clipped and divided.

We followed our patients for 90 days postoperatively for sternal wound complications, new cardiac incidence, pain at the site of incision, and pulmonary complications.

The data collected during the period of follow-up were tabulated before preparing it for the statistical analysis; this data did not include any personal or private information of the patients.

Statistical analysis of the data

The data was fed to the computer and then was analyzed by using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) Qualitative data is described using numbers and percent. Kolmogorov-Smirnov test is used to verify the normality of the distribution Quantitative data is described by using the mean and standard deviation. The results were considered significant at the 5% level.

Chi-square test was used for categorical variables, to compare between different groups, Fisher's Exact or Monte Carlo correction when more than 20% of the cells have expected count less than 5, Student t-

test For normally distributed quantitative variables, to compare between two studied groups, Mann Whitney test For abnormally distributed quantitative variables, to compare between two studied groups

Results

The patient demographics and patients' risk factors show no statistical differences between the two groups as expressed in (**Table 1**).

Table1: patient demographics and patients' risk factors.

Variables	Pedicted (n = 50)	Skeletonized (n = 50)	P value
Gender(Female)	6(12 %)	8 (16 %)	0.564
Age (years) Mean ± SD.	58.14 ± 7.34	57.60 ± 7.84	0.723
Weight (kg) Mean ± SD.	86.24 ± 11.11	88.74 ± 10.70	0.255
Height (cm) Mean ± SD.	170.28 ± 6.42	171.10 ± 7.23	0.550
BMI (kg/m ²) Mean ± SD.	29.93 ± 5.05	30.35 ± 3.83	0.637
Smoker	19 (38 %)	23 (46 %)	0.418
DM	23 (46 %)	19 (38 %)	0.418
HTN	30 (60 %)	26 (52 %)	0.420

SD: Standard deviation ; BMI: Body mass index

There is no significant difference between the two groups regarding the number of vessels. There is no significant difference in P-value significant difference between the two groups regarding the mean of postoperative drainage (pedicled group

between the two groups in regard to arrhythmia, duration of ventilation and ICU stay. However, there is versus skeletonized group) (486.0 ± 321.99 versus 338.0 ± 241.29)(P-value <0.001) as demonstrated in (**Table 2**).

At 3 months follow-up, there were no detected cases of post operative complications. There is no significant difference in P-value between the two groups in regard to pain superficial

myocardial infarction or pulmonary wound infection and sternal dehiscence at 3 months follow up as demonstrated in (Table 2).

Table 2. Comparison of operative, postoperative outcomes and complications between pedicled and skeletonized LIMA

Variables	Pedicled (n = 50)	Skeletonized (n = 50)	P value
Grafts number Mean ± SD.	3.10 ± 0.68	2.98 ± 1.06	0.436
Post-Operative drainage (ml / 24 hours) Mean ± SD.	486.0 ± 321.99	338.0 ± 241.29	<0.001*
Arrhythmia	2 (4 %)	3 (6 %)	^{FE} p= 1.000
Duration of ventilation (hours) Mean ± SD.	5.0 ± 2.52	4.02 ± 1.91	0.436
ICU stay (Days) Mean ± SD.	4.94 ± 1.20	4.84 ± 1.04	0.771
Pain	6 (12 %)	4 (8 %)	0.505
Superficial wound infection	2 (4 %)	3 (6 %)	^{FE} p= 1.000
Sternal Dehiscence	1 (2 %)	1 (2 %)	^{FE} p= 1.000

SD: Standard deviation

*: Statistically significant at $p \leq 0.05$

FE: Fisher Exact test

Discussion

As the way to harvest the (IMA) to achieve the best advantage is still a point of debate, we aim to assess the short term clinical outcome of both pedicled and skeletonized techniques. In our study, pedicled harvesting of (IMA) was associated with increased postoperative drainage. This may be due to the large raw area after (IMA) harvesting by pedicled technique in comparison to a small raw area after (IMA) harvesting by skeletonized technique.

This is consistent with a study by **Ozulku et al.(2016)** enrolled 160 patients who underwent CABG surgery, the study revealed that the amount of postoperative drainage was significantly greater in the pedicled group so they concluded that postoperative blood loss is affected by the differences in the technique of harvesting (IMA).

Also, according to **Succi et al.(2020)** pedicled technique was associated with increased post operative bleeding than skeletonized technique.

According to **Shaheen et al.(2020)** there was no significant difference between the pedicled technique and the skeletonized technique in regard to the amount of

postoperative drainage in the first 24 hours. However, there were a greater number of patients who required re-exploration after pedicled harvesting of (IMA).

In contrast, according to **Sazzad et al.(2016)** the difference between both techniques was insignificant as regard post operative drainage.

Bleeding is a common complication after cardiac surgery that may need blood transfusions which carry the risk of infection transmission in the form of mediastinitis, respiratory infection, and sepsis, it is also associated with more attacks of atrial fibrillation, stroke, and the risk of acute renal failure with more hospital stay (**Dorneles ,2011**).

In our study, the difference was insignificant between both groups in regard to arrhythmia. This is in consistence with the results of the study conducted by **Kamel et al.(2021)**.

In our study, the difference was insignificant between both groups in regard to the duration of ventilation, this is in consistence with the results of the studies conducted by **Sazzad et al.(2016)** and **Kamel et al.(2021)**.

But this is in contrast to **Peterson et al.(2003)** study which was

conducted on bilateral mammary harvesting and concluded that pedicled technique was associated with increased duration of ventilation postoperative in comparison to skeletonized technique. **Abboud et al.(2004)** in their study revealed that the prolonged stay in the intensive care unit is associated with increased the risk of wound infection. In our study, there was no significant difference between the two groups regarding ICU time post-operative.

This is in consistence with the results of the study conducted by **Sazzad et al.(2016);Shaheen et al.(2020) and Kamel et al.(2021)**. In contrast **Peterson et al.(2003)** concluded that skeletonization was associated with lower ICU stay but this study was conducted on bilateral mammary harvesting.

In our study the difference was insignificant between both groups in regard to postoperative pain at 3 months follow-up.

This is in consistence with the results of the study conducted by **Memon et al.(2016)** which revealed that skeletonized harvesting of (IMA) was not associated with reduced pain post coronary artery bypass graft surgery at the end of one month

intervals. They proposed that the skeletonization of (IMA) may be beneficial when bilateral (IMA) is needed.

In contrast, **Bawany et al.(2014)** study revealed that skeletonization of (IMA) was associated with significant reduction of pain post (CABG) surgery both at 1 and 3 months follow-up in a study that included 50 patients, but did not determine if it was on single or bilateral (IMA).

In A randomized trial conducted by **Boodhwani et al.(2006)** revealed that harvesting the (IMA) using a skeletonized technique leads to a significant reduction of pain at three months follow up postoperatively.The study included 48 patients who had bilateral (IMA) harvesting with skeletonized mammary on one side and pedicled mammary on the other side.

In our study, the difference was insignificant between both groups in regard to postoperative sternal dehiscence and sternal wound infection at 3 months follow-up. Sternal wound complications are considered a great point of debate between literature. In a substudy of The Arterial Revascularization

Trial conducted on 2056 patients, **Benedetto et al.(2016)** concluded that skeletonized single internal mammary artery harvesting was not associated with more benefits in comparison to pedicled single internal mammary artery harvesting regarding the risk of sternal wound complications and it was associated with bilateral internal mammary artery harvesting.

In a study by **Lazar et al.(2018)** they studied the different effects of both pedicled technique and skeletonized technique of harvesting (IMA) on sternal wound infection after (CABG) operation, and the conclusion was that The development of sternal wound infection following (IMA) grafting is considered multifactorial and independent of the technique of harvesting.

In a Meta-analysis study by **Kusu-Orkar et al.(2021)** including Thirteen articles with a total of 6222 patients, there was no significant difference between the skeletonized and pedicled groups in regard to sternal wound infection rates.

List of Abbreviations

BMI: Body mass index

CABG: Coronary artery bypass graft

IMA: Internal mammary artery

LAD: Left anterior descending

SVG: Saphenous vein graft

On the other hand, a study by **Kamiya et al.(2008)** enrolled 24 male patients for isolated coronary artery bypass graft surgery and concluded that the skeletonization of (IMA) was associated with significantly less damage of the tissue microcirculation in the middle and lower retrosternal area in comparison to that after the pedicled (IMA) harvesting technique by using a laser doppler flowmetric and remission spectroscopic system.

Also, **Boodhwani et al.(2006)** concluded that sternal perfusion was better after the skeletonized technique than after the pedicled technique by using radionuclear perfusion scanning.

Conclusions

From the findings of our study, it is concluded that, short term outcomes of pedicled left (IMA) and skeletonized left (IMA) are nearly equal except that the skeletonized technique is superior in regard to the amount of post operative drainage in comparison to the pedicled technique.

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